

Surface Ozone in the Schoolyard

Purpose:

- To teach children how to measure, graph and analyze local surface ozone data
- To enhance the existing knowledge about surface ozone

Educational Outcomes:

- Reading and recording data accurately
- Appropriate data representation & analysis
- Cause and effect (observe & explain reactions)
- Interconnection of meteorology and surface ozone concentrations
- Identifying patterns in surface ozone production

Time:

- Two five-minute periods, one hour apart (take measurement)
- 15 minutes graphing and analyzing data
- 30 minutes assessing current level of knowledge

Level:

- Intermediate, advanced

Frequency of Measurements:

- Daily within one hour of local solar noon.

Key Concepts:

- Ozone exists in the air we breathe
- Ozone concentrations change

Skills Developed:

- *Measuring* the level of surface ozone in ppb
- *Recording, graphing, and analyzing* data
- Following directions to achieve systematic sampling procedure
- *Observing and recording* atmospheric conditions
- Working in a group environment

Materials and Tools:

- Student protocol
- Surface Ozone Investigation Data Work Sheet
- Clipboard and pencil or pen
- Sealed plastic baggie to carry chemical strip to monitoring station
- Surface Ozone Hand-held Scanner
- Chemical test strip in plastic baggy

Prerequisites:

- Able to read minimum/maximum and current temperature at GLOBE Weather Station
- Read GLOBE Cloud Chart and estimate cloud cover

- Able to use check list for team self assessment
- Able to use rubric for individual assessment
- Able to calibrate the ozone hand-held scanner

Introduction:

The quality of air surround the Earth is affect by the composition of the air. The atmosphere is composed of a mixture of gases, and gases entering the atmosphere influence changes in the atmosphere. By systematically monitoring different gases, scientists can determine if the composition of the atmosphere is changing and what those changes may be over a period of time.

Collecting surface ozone data will provide a database of the concentration of surface ozone being produced in the local area, and the atmospheric conditions that influence it production. The students will be able to compare their data to that obtained in other geographic regions.

Lesson Design:

The lesson is designed to facilitate:

- 1) development of a common level of knowledge and background for the activity;
- 2) immediate involvement of students with the topic of surface ozone;
- 3) opportunities for students to analyze what they know, need to know, and have learned about surface ozone;
- 4) development of team discussions to process what they are learning with opportunities to share and clarify what they are learning with the whole class;
- 5) a closing activity involving students responding in their Globe Student Science Notebooks using a rubric to independently assess their level of response.

As the students write in their science notebooks, it is recommended that the teacher write in a notebook modeling the importance of journaling. To make journaling more valuable to the students and lead into the topic for the next day, begin the lesson with the students sharing their journal responses in their team. Discussions in small groups help students to think, process, analyze, and apply their knowledge in science.

How to Do It:

The following sequence provides a last minute checklist to facilitate the integration of the activity within a scheduled sixty-minute period.

Classroom Preparation:

- Thirty minutes before the lesson, place 5 ozone strips (enough for 5 teams) at the monitoring station and record the starting time.
- Prepare one set of the following materials for each team: 1 clipboard with pencil attached, 1 data sheet, 1 small plastic baggy for carrying the ozone strips, 1 GLOBE Cloud Chart, and 1 surface ozone color chart or hand held scanner.
- Copies of the Student Ozone Protocol collaborative skills check list, and the rubric for guide science notebook writing.
- A transparency of the graph format to model graphing daily data on the overhead projector

- Demonstrate calculating solar noon and establish the time each day to place the chemical strip

Student Preparation: Surface Ozone Measurement Procedure:

- Organize the class into teams of 3-4 students and have each team decide who will be the recorder, facilitator, scientist, and reporter. If there are only three members on the team, the facilitator can also be the reporter.
- Provide each team facilitator with copies of the Surface Ozone Protocol-Student Sheet with a practice data sheet to share with team members. Ask the teams to review the protocol and to make sure everyone on the team understands the directions for taking and recording a surface ozone measurement. Also give the teams a collaborative skills check list and explain the purpose for using it. Each student is expected to place the protocol, activity sheets, and assessment tools in their GLOBE Student Science Notebooks along with their record of daily work.
- Review the team procedure and provide each student with a checklist for team assessment. It may also be used by the teacher to assess the team's collaborative skills and used for a team conference to build collaborative skills. The checklist may be modified to support collaborative skills you want your students to specifically developing during this process.
- Ten minutes before it is time to go to the monitoring station, have the recorder from each team get the materials organized for fieldwork. Ask the recorder to review and check off materials on their checklist.
- Place a section of 5 ozone strips in a small plastic bag. Identify one team that will be responsible for carrying and placing the ozone strips in the clip of the monitoring station.
- Remove the previously placed set of ozone strips and have the team place the next give in the clip. Ask the scientist from each team to pick up chemical strip from you. Discuss with the scientists the handling procedure for the chemical strip to ensure an accurate reading.

Student Assessment:

1. Collaborative skills checklist
2. Rubric for assessing GLOBE Student Science Notebook

Procedure:

Focus Activity-In the Field Testing

It is important to do the actual reading of the chemical strip in the field, weather permitting, to minimize the possible contamination of the strip from overexposure or possible contamination of the chemical on the strip from handling it. Provide the teams with the time the original sample test strips were placed and removed for reading. Working in small teams, have the students place the chemical strip in the hand held scanner. Be sure the bottom edge of the chemical strip is evenly placed at the bottom of the slot in the scanner and record the results. After recording the level of ozone, record the current temperature, and cloud type and cover.

Review the data collecting process with the class and answer any questions students may have about the procedure. Develop a schedule for each team to take turns placing and collecting the

chemical strips and collecting data for seven consecutive days. Place the clipboard and team schedule in a student accessible location.

Upon returning to the classroom, provide each student with a copy of the sheet to be used to graph data. Using the overhead or the board, demonstrate plotting the level of ozone and then, using the right side of the graph, locate the temperatures and plot the day's current temperature. Demonstrate how to set up a legend for the graph. Students should keep their individual graphs in their science notebooks, and graph the data for five consecutive days for use comparing and analyzing local data.

Classroom Investigation-Assessing Existing Knowledge

What do students already know about Surface Ozone, or think they understand? To assess the level of existing knowledge, have the students work in their teams to identify the following areas of information:

- What do we know about surface ozone?
- What can we learn about surface ozone from our data?
- What have I learned about surface ozone?

Provide the students with large sheets of paper (approximately 24" x 30") and markers. Have the recorder on each team design a grid with three columns and place one question at the top of each column. The team shares and records their answers to the questions and the recorder

SURFACE OZONE		
KNOW ABOUT SURFACE OZONE	CAN LEARN ABOUT SURFACE OZONE DEOM OUR DATA	HAVE LEARNED ABOUT SURFACE OZONE

writes their responses in the appropriate column. When they have completed their lists, have the reporter from each team present each column. Record their responses on the board on the overhead using the same format. At this time no judgement is made about any contributions. Misunderstandings may be corrected as students study the topic. Save the teams sheets, and at a future date repeat the activity and have the students cross out the misunderstandings they identify on the original list.

Using the student sheets, have them identify what they can learn about surface ozone and brainstorm questions. Sort those questions into three general categories:

Questions that can be answered by our own data

Questions that can be answered by using data and other information from the GLOBE Web Site

Questions that require researching the topic

Use the questions that can be answered by using their own data, and identify sample questions that will help them focus on analyzing their data after collecting it for a week. The following are sample questions that might be developed:

1. Do you think you will have the same level of surface ozone each day? Why or why not?
2. Explain what you observed about the level of surface ozone on cloudy versus sunny days.
3. Describe the relationship of temperature to the production of surface ozone.
4. What other factors can we compare to the level of surface ozone measured and what might they tell us?

Assessment

Give each student a copy of the rubric that describes the criteria for assessing their journal response to determine what each student has learned from the data she/he collected.

Journal Exit Question: *What have I learned about surface ozone from recording and graphing data for one week? A month?*

Helpful Hints

Once the routine for collecting data is in place, occasionally check the data sheet to ensure data are being recorded accurately.

Design a way to help the students remember to return to the site to collect data. Sometimes they remember to place the ozone strip, but forget to return within an hour to record the results.

Occasionally students may copy the information off the chart, and accidentally take it with them. To prevent this, make an extra copy to post for student use. Remind the students that once the data is submitted to the GLOBE Web Site, they can retrieve it for future analysis.

Educational Advantages of using this Activity

1. Involving students in “real world” science and problem solving activities
2. Activities designed to meet the Educational needs of multiple intelligences and different learning styles:
 - a) *Interpersonal* learner through cooperative group activity;
 - b) *Intrapersonal* learner through reflecting on their experience in the GLOBE Student Science Notebook;
 - c) *Linguistic* learner through reading, research, writing, and communicating;
 - d) *Logical-mathematical* learner through measuring, collecting, and analyzing data;

- e) *Visual* learner through cloud cover observations and graphic summaries;
- f) *Kinesthetic* learner through hands on experiences collecting data; and,
- g) *Naturalist* through direct involvement in learning about his or her own world.

Interdisciplinary Links and Extensions

Language Arts

Research and write a report on the sources of gases entering the atmosphere and needed to produce surface ozone.

Read about the Biosphere Project and the issues they had to cope with to maintain a controlled environment.

Technology

Use GLOBE Web Site to gather information about the characteristics of the land, water, and air in different regions to compare to local features.

Design a web page about your surface ozone exploration and conclusions drawn.

Music

Write a folk song or create a dance and put it to music to explain the behavior of atmospheric gases.

SURFACE OZONE IN THE SCHOOLYARD

Student Rubric for Assessing Science Notebook

The response in your GLOBE Student Science Notebook demonstrates your level of understanding and mastery of the science concepts, skills, and procedures being applied during this lesson. The information is reflected in your response in your science notebook through:

- accurately recording data each day;
- comparing your team's data with data collected by other science teams;
- summarizing & explaining the relationship of the weather conditions to the production of surface ozone; and
- your thoughts identifying how the study relates to your world.

Surface Ozone in the Schoolyard – Rubric for Assessment

4 FULLY DEVELOPED

- Science notebook well organized with all work completed to date
- Accurately recorded surface ozone data for specified period of time
- Compared data to most of the other team's data to assure quality
- Created data tables and graphs of data (ex. ozone level to cloud cover, temperature, wind speed and direction,) to compare and analyze
- Described in detail the relationship of the weather conditions to the production of surface ozone and used own data to support explanations
- Explained how study develops understanding of the atmosphere and relates to own life

3 ADEQUATELY DEVELOPED

- Science notebook well organized with all work completed to data
- Accurately recorded surface ozone data for specified period of time
- Compared data to 3-4 other team's data to assure quality
- Created two data tables and graphs using daily ozone measurements, cloud cover and temperatures to compare and analyze
- Described in detail the relationship of two climate conditions that affect the production of surface ozone and used own data to support explanation.
- Briefly explained how study relates to own life

2 PARTIALLY DEVELOPED

- Science notebook partially organized with most of the work completed to data
- Recorded all data for specified period of time with minor errors in reading instruments
- Compared data to at least one other team's data
- Slightly off in measurements, but team detected errors
- Created two data tables and graphs using ozone measurements, cloud cover and temperatures but table and graphs have many errors
- Described relationship of two climate conditions that affect the production of surface ozone with partial accuracy, but data and graphs may or may not support explanations.
- Briefly shared a personal thought about the study, but it was not clear.

1 NEEDS TO BE DEVELOPED

- Science notebook poorly organized and missing work completed to data
- Inaccurately read and recorded surface ozone data
- Missed comparing data to another team
- Did not detect errors in data collecting
- Inaccurate or missing data tables and graphs
- Explanations or personal thoughts confusing, not accurate, or not included

What does teamwork look and sound like? There are many criteria that can be considered, and the following chart reflects a sample that can be used to observe how a team is cooperating. Students can use the same criteria to assess themselves and identify what worked well and what the team needs to improve on to share with a teacher during a team/teacher conference.

Teamwork Checklist

Criteria for Assessment	Team 1	Team 2	Team 3	Team 4	Team 5
LOOKS LIKE Sitting in a closed circle					
Team focused on Completing task					
Have eye contact with Person speaking					
Nodding in agreement With student speaking					
Leaning into Discussion					
Sharing & assisting Others on team					
Listen to all Ideas					
SOUNDS LIKE Each team member filling role on team					
Address each other by first names during discussion					
Discussion focused on task					
Dialogue reflects communications like: I agree because... I disagree because.. What do you... How can we... Can you explain.. That's an interesting idea and I think..					
Different members share ideas					